

# Chocolicious

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## Overview of Lesson

In this activity, students will analyze an advertisement and survey of a new product. Looking at the survey, graphs, and claims the company made, students will determine if they are biased or fair and determine if the information was misrepresented or not. They will use the components of an ideal sampling process (randomized, over 30 units sampled, representative of the larger population, using an objective instrument) to create a survey of their own. Conclusions will be drawn from the critique and analysis of their peers surveys.

## GAISE Components

This investigation follows the four components of statistical problem solving put forth in the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report*. The four components are: formulate a question, design and implement a plan to collect data, analyze the data by measures and graphs, and interpret the results in the context of the original question. This is a GAISE level C activity.

## Common Core State Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

## Common Core State Standards Grade Level Content (High School)

S-IC. 1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

S-IC. 3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

## NCTM Principles and Standards for School Mathematics

### Data Analysis and Probability Standards for Grades 9-12

**Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them:**

- Understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each;

- Know the characteristics of well-designed studies, including the role of randomization in surveys and experiments.

**Develop and evaluate inferences and predictions that are based on data:**

- Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference;
- Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions.

**Prerequisites**

Students will know how to interpret graphical data. Prior to this activity students should understand that a sample is a random selection of a subset of data from a larger population.

**Learning Targets**

Students will be able to analyze and interpret the given data. Students will be able to understand and evaluate random processes underlying statistical experiments. Students will be able to make a fair and unbiased survey.

**Time Required**

Two 50 minute periods or 1 block period (75 minutes).

**Materials Needed**

1 student worksheet per student  
1 analysis sheet for each survey made  
Copies of the student made surveys  
Display of PowerPoint materials

**Instructional Lesson Plan**

**The GAISE Statistical Problem-Solving Procedure**

**I. Formulate Question(s)**

Begin the lesson by having students bring in (or provide) newspaper or magazine articles or advertisements that contain statistics to show them how often statistics are quoted in everyday life. Look at all of the examples and how some could be biased to show what the company wants and also talk about the small print.

Show the PowerPoint presentation and have students write out any questions that come from looking at this advertisement or anything they notice that doesn't fit in the presentation. Give students the activity sheet (attached, pages 8-11), which will give them the relevant information presented by Dodgycereals.

After looking through the PowerPoint and the resource sheet students should brainstorm questions that they would like to investigate about the way that the statistics for this advertisement were acquired and displayed. Lead a class discussion to generate a set of questions and have a volunteer record them on the board. These questions should help the students begin to think about what is wrong and right with the survey, the information, and how it is presented.

Some possible questions might be:

1. Was the amount of teenagers surveyed an adequate amount?
2. How should teenagers be chosen to be surveyed?
3. Was the survey written in a way so that participants would answer in a certain way?
4. Why are the graphs (titles, scales, measurements) made this way?
5. Are the claims being made relevant to the product?
6. Do the graphs and wording throughout show the results that were found in the survey answers?
7. Are the advertisement questions relevant to the Chocolicious product?
8. What is the small print telling us?
9. Can they make a claim and not prove it? (Show cause and effect.)
10. How does this ad relate or is similar to real life ads?

### III. Analyze the Data

Have students take a closer look at the resource sheet. As they go through each section, ask students to look at it and see what may have produced misleading data or how the data is portrayed in a way that is misleading. Possible answers include:

For the survey:

- Ask for employee number, not confidential
- In directions they tell you what they believe (how you should answer)
- In directions they say that the new candy bar is for intelligent and gorgeous teenagers
- Options for the questions are limited
- Small sample size (only 30)
- Sample is entirely from the company employees children, so it is a biased sample

For the tables:

- Do an accurate job of reporting the survey results

For graph 1:

- Scales are written as odd decimals, making 3.75 look like 375
- Graph has been stretched to make it look like a much larger gap than it is
- Starts at 3.75 to make the differences look larger

For graph 2:

- Drawn correctly but still misleading
- Looks like 100% of respondents don't eat breakfast
- Doesn't show how many teenagers responded for each age group

For the claims:

- Intelligence of the teenagers wasn't collected
- 1/3 of males eat breakfast, 1/3 is not 'hardly any'
- Saying females are more discerning and gorgeous than males are value judgments
- Doesn't explain that more females were surveyed than males
- Saying almost all don't eat breakfast because the cereal is for old people is inaccurate

- Only 4 students responded to being rushed in the morning, that isn't enough to say that younger teens are more disorganized
- Only 4 13-15 year olds were surveyed. It is not accurate to say all when such a small number were surveyed.

#### **IV. Interpret the Results**

Using the lists that students made above, they should interpret the results of their findings.

Determine if the advertisement was misleading or not.

Sample: The sample size was too small and only included employee's children. Only having 30 teenagers from one area is not random so the results and claims are not valid. Surveying the children of employee's could have biased the way that they answered the questions.

Survey: The employee number was included so they could have answered in the way that Dodgycereal Limited wanted them to respond to make sure their parents jobs were safe. In the instructions there was an implied right answer, which was that teenagers don't eat breakfast because the cereal their parents buy is for old people. They also say that Chocolicious is for young, discerning, intelligent, gorgeous teenagers. The answers in the multiple choice are also very limited with a lack of good choices for survey takers to choose. These survey questions were leading.

Graphs: These were misleading: scales on graph, size of graph, percentages hiding small sample size. They don't say how small the sample size is.

Claims: Often inferred rather than backed up by the analysis. Ex. Intelligence, gorgeous, discerning. Say all multiple times and with such a small sample size that is very misleading.

Conclusion: The graphs and claims are misleading. They are biased to show what the company wants—that teenagers don't eat breakfast because cereal is for old people and everyone would want to eat a chocolate bar for breakfast.

#### **II. Design a Plan to Collect Data**

After analyzing and interpreting the results everyone should agree that the survey was not representative of teenagers. We want to make a new survey for Dodgycereal to use that is unbiased and still answers all of the questions. Ask students what makes a fair and unbiased survey. Have them brainstorm and share with the whole class. The list should include the following:

- Questions should be short, simple, and direct
- Phrase questions so that they can be understood by every respondent
- Phrase questions so as to avoid bias that may predetermine a respondent's answer
- Avoid questions that might mislead because of unstated assumptions
- Avoid leading questions, which imply a desired response
- Avoid questions that may elicit embarrassment, suspicion, or hostility in the respondent
- Avoid double barreled questions, which attempt to ask two questions in one
- Keep questionnaire as brief as possible so that it requires a minimum of the respondents time
- Well organized and sequenced
- Response choices that fit all possibilities

Not all categories need to be discussed, if the list appears to include the larger idea. Make sure that students are thinking of their objective and what they are trying to find through their survey.

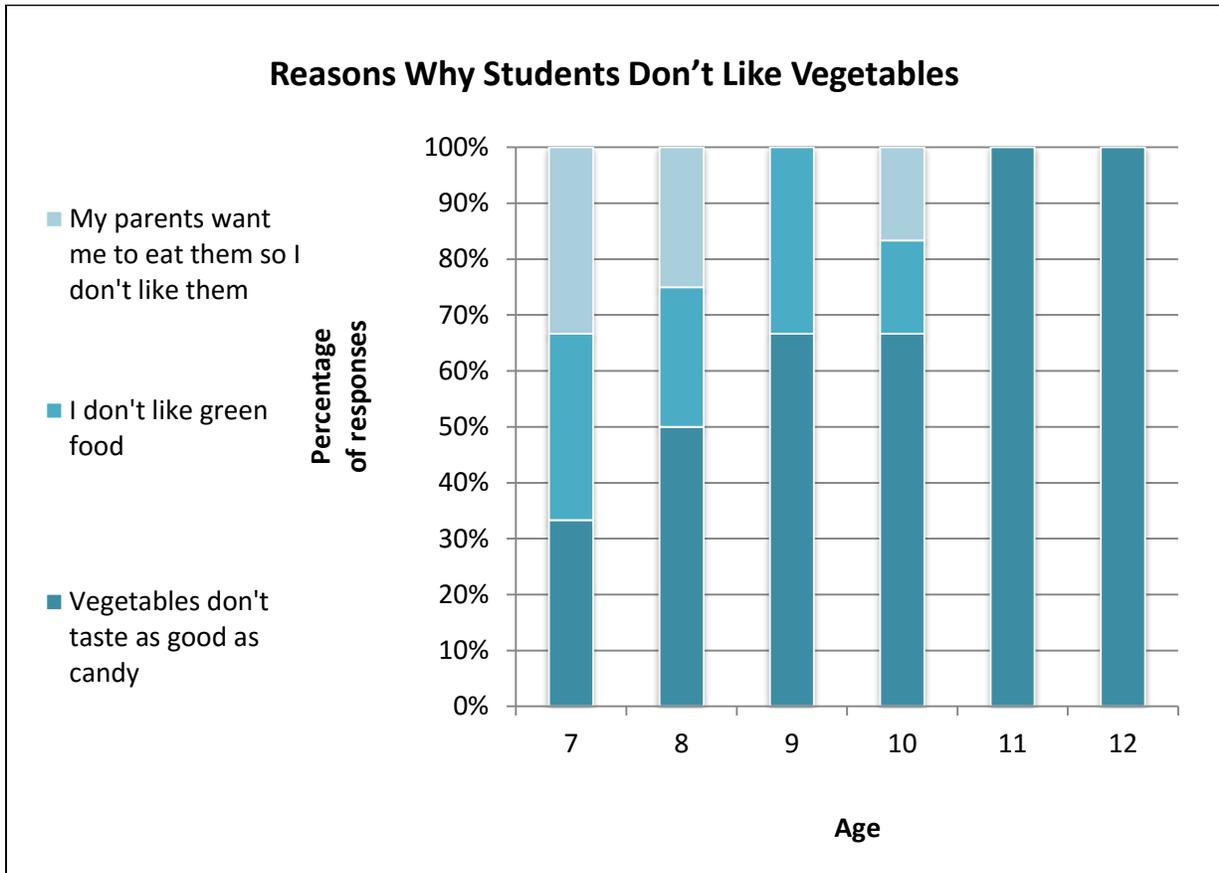
Have students work in small groups to make their own survey for Dodgycereal to get information regarding teenager's breakfast habits. Along with making the survey they should also include who they would survey. Include the sample size and how it would be chosen. As students are making their surveys walk around and make sure they are on the right track.

### Assessment

1. Survey Question: No kids like eating healthy, what's your least favorite fruit or vegetable?
  - a. Broccoli
  - b. Asparagus
  - c. Apple
  - d. Mango

What is wrong with this survey question?

2. Graph: Is the graph below misleading? Why or why not?



3. Sample Size: A company conducted a study choosing 5 students randomly from each high school in the state. Is this a good sample size? Why or why not?

## Answers

1. Begins by saying no kids like eating healthy which leads to bias and is unfounded. The answer choices don't include all possible fruits and vegetables.
2. It looks like all kids don't like eating healthy foods; it doesn't give how many kids responded for each age group, and the colors of the graph make it difficult to read.
3. Yes it is, it is relatively large and random.

## Closure/Reflection

Give students these questions as an exit slip.

How did this activity change your thinking about advertisements and data that is reported in magazines and newspapers? Explain your answer.

How can this be translated into your everyday life? What information has been provided to you inaccurately?

## Possible Extensions

1. Students can use the random sampler at the Census at School website <http://amstat.org/censusatschool/index.cfm> to create graphs and claims.
2. Students can administer the survey to their peers in the class or around school. They could follow this up by analyzing the data and making new graphs like the makers of Chocolicious did.
3. Students can find an advertisement or report of data online and determine if the data and results are sound or misrepresentative.

## References

1. *Guidelines for Assessment and Instruction in Statistics Education* (GAISE) Report, ASA, Franklin et al., ASA, 2007 <http://www.amstat.org/education/gaise/>
2. This activity is based on the activity by Joanne Woodward titled *Chocolicious* on the Census at School website <http://www.censusatschool.org.nz/>
3. *Introduction to Research in Education*, Ed. 7, Donald Ary, Wadsworth, Inc., 2006.

## Chocolicious Activity Sheet

After seeing the Chocolicious advertisement, what is your initial response?

Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Dodgycereals had a plan. They surveyed 30 American teenagers about breakfast foods. To help you decide if Dodgycereal's claims are misleading they have provided you with the survey they used, the data they gathered and their analysis.

The survey looked like this:

Employee number: \_\_\_\_\_

Dodgycereals Limited, your employer, believes students don't eat breakfast because the options parents buy are for old people. We have developed a new chocolate flavored cereal block 'Chocolicious' for the young discerning intelligent gorgeous teenager.

Please ask your teenager the following questions:

- 1) Age \_\_\_\_\_
- 2) Gender: male/female
- 3) Do you eat breakfast Yes (go to Qu. 5)  
No (go to Qu. 4)
- 4) Why don't you eat breakfast? a) The cereal my parents buy is for old people b) It's too messy in a bowl, I would rather eat a block of cereal c) I am too rushed in the morning to sit down and eat
- 5) Would you eat a chocolate flavored block for breakfast? Yes/No

Thank you for completing this survey.

Dodgycereals Limited got their data from a single survey they conducted. All of the 8 company employees who had teenagers took the survey home.

**Analyze the survey and sample group:**

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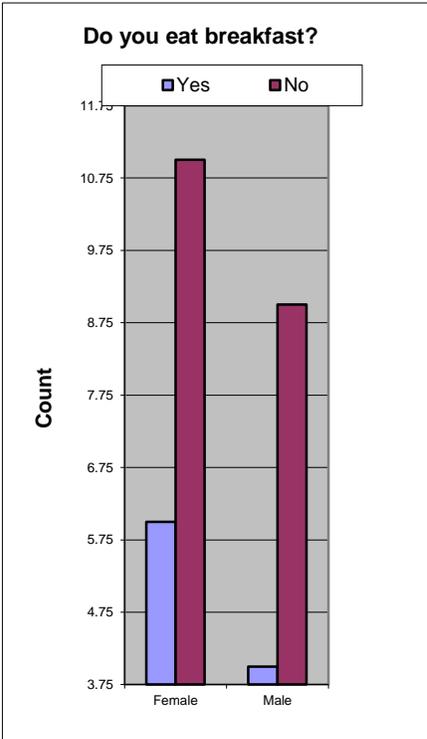
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These tables show the results of the survey:

	<b>Do you eat breakfast?</b>	
<b>Gender</b>	Yes	No
<b>Female</b>	6	11
<b>Male</b>	4	9
<b>Total</b>	10	20

	<b>Why don't you eat breakfast?</b>			
<b>Age</b>	<b>The cereal my parents buy is for old people</b>	<b>It's too messy in a bowl, I would rather eat a block of cereal</b>	<b>I am too rushed in the morning to sit down and eat</b>	<b>Total</b>
<b>9</b>	1	1	1	3
<b>10</b>	2	1	1	4
<b>11</b>	2	1	0	3
<b>12</b>	4	1	1	6
<b>13</b>	3	0	0	3
<b>15</b>	1	0	0	1
<b>Total</b>	13	4	3	20

Here are the graphs and the claims that Dodgycereals Limited made.



**Graph 1**

☆ Hardly any teenagers eat breakfast – especially intelligent males.

☆ Females are more discerning than males because more of them don't eat breakfast.

☆ Females are also more gorgeous than males

**Analyze graph 1 and its claims:**

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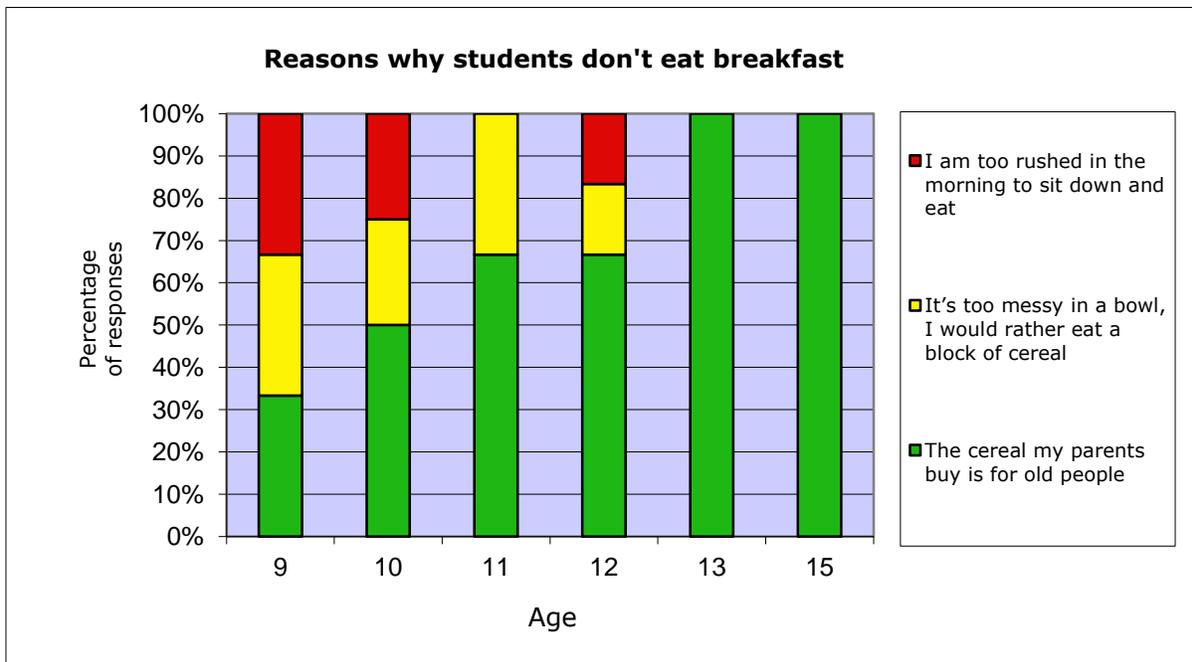
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**Graph 2**

Dodgycereals Limited used this graph to claim that:

- ☆ Almost all teenagers don't eat breakfast because the cereal their parents buy is for old people.
- ☆ Younger teenagers are more disorganized than older teenagers as they are too rushed to eat breakfast in the morning.
- ☆ All 13-15 year old teenagers didn't eat breakfast because the cereal their parents buy is for old people.

**Analyze graph 2 and its claims:**

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**After looking at all pieces of this advertisement, is this fair and unbiased or not? Explain your answer.**

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